Near-Term Research Priorities

Historical Lake Conditions

1. Historic Trophic State of and Nutrient concentrations in the Paleo Record of Utah Lake
   - What are **historic P, N, and Si concentrations in sediment cores** (SP charge 1.2)
   - What does the **diatom community** and **macrophyte community** indicate? (SP charge 1.1.i, ii, iii)
   - What do **photopigments** and **DNA** indicate? (SP charge 1.4)

Current Lake Conditions

2. Bioassays to Investigate Nutrient Limitation in Utah Lake
   - Which **nutrients are controlling primary production and HABS** and when (SP charge 2.3.ii)
3. Utah Lake Sediment-Water Nutrient Interactions
   - What are **sediment equilibrium P concentrations**?
   - What effect is the **effect of reducing inputs** on in-lake concentrations?
   - What is the **lag time** for lake recovery? (SP charge 2.4.i)
   - What is the **role of calcite "scavenging" in the P cycle**? (SP charge 2.3.v)
   - What is the **sediment oxygen demand of,** and **nutrient release** from, sediments? (SP charge 2.4.ii)

2019 Research (ULWQS)

2019 Contracted Research

1. Bioassays to investigate nutrient limitation in Utah Lake

2. Historic trophic state and nutrient concentrations in the paleo record of Utah Lake

3. Utah Lake sediment-water nutrient interactions

Paleo Record

Objectives

1. What were the historical phosphorus, nitrogen, and silicon concentrations as depicted by sediment cores?
   - Science Panel charge 1.2

2. What does the diatom community and macrophyte community in the paleo record tell us about the historical trophic state and nutrient regime of the lake?
   - Science Panel charge 1.1

3. What do photopigments and DNA in the paleo record tell us about the historical water quality, trophic state, and nutrient regime of the lake?
   - Science Panel charge 1.4

Paleo Record

UTAH LAKE COMMISSION

UTAH DEPARTMENT of ENVIRONMENTAL QUALITY WATER QUALITY

UVW

BAYLOR BEARS

MISSISSIPPI STATE

CAROLINA TAR HEELS

UTAH STATE

BYU

COLLEGE OF ENGINEERING THE UNIVERSITY OF UTAH

WFWQC FORSGREN Associates Inc

Bioassays

Objectives

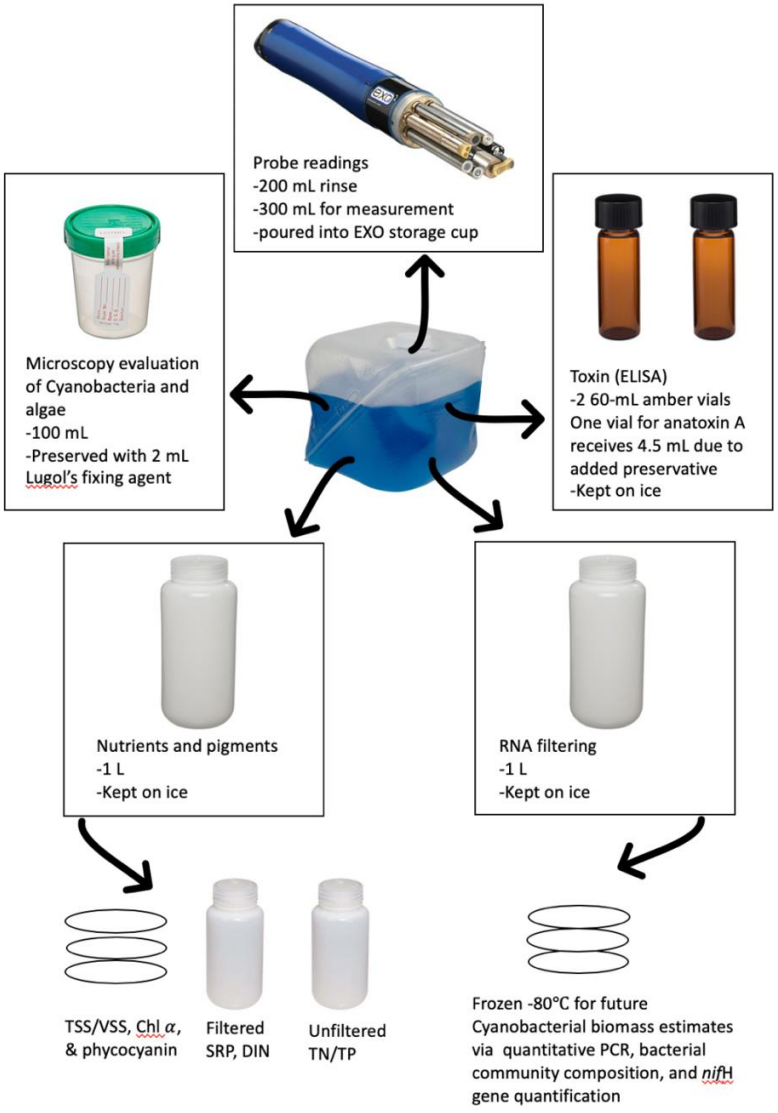
1. Which nutrients are controlling primary production and HABS and when (SP charge 2.3.ii)
   - Determine seasonality of nutrient limitation
   - Determine spatial dynamics of nutrient limitation

UTAH LAKE COMMISSION
UTAH DEPARTMENT of ENVIRONMENTAL QUALITY WATER QUALITY
UW BAYLOR BEARS MISSISSIPPI STATE CAROLINA TAR HEELS UTAH STATE BYU COLLEGE OF ENGINEERING THE UNIVERSITY OF UTAH
WFWQC FORSGREN Associates Inc

Bioassays

Objectives

1. Which nutrients are controlling primary production and HABS and when (SP charge 2.3.ii)
   - Determine seasonality of nutrient limitation
   - Determine spatial dynamics of nutrient limitation

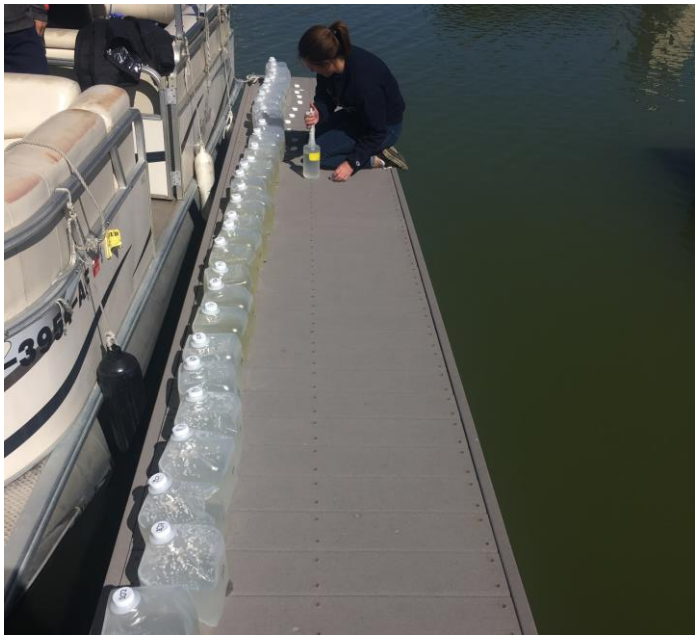


Bioassays

Measurements and Tasks Completed

1. Water chemistry sonde: pH, temperature, electrical conductivity, dissolved oxygen, turbidity, dissolved organic matter, blue green algae-phycocyanin, and chlorophyll-a
   - Summer = S, Late Summer = LS, Fall = F
2. Chlorophyll-a (ethanol extraction)
   - S, LS
3. ELISA toxins (microcystin, anatoxin-a, and cylindrospermopsin)
   - S, LS
4. TSS and VSS to estimate photosynthetic biomass
   - S, LS, F
5. TP, TN, SRP, and ammonium and nitrate
   - S, LS
6. Cyanobacterial species and algal division composition direct microscopy
   - S and most of LS
7. RNA transcript extractions
   - Started S
8. RT-qPCR cyanobacteria biomass
9. RT-qPCR of nifH to estimate biological nitrogen fixation
10. Sequencing of cyanobacterial composition
11. Investigate relationship between *nif* H gene expression and measured nitrogen fixation rates

Bioassays



Sediment-Water Interactions

Objectives

1. What are current sediment equilibrium phosphorus concentrations (EPC) throughout the lake?
   - Science Panel charge 2.4.i

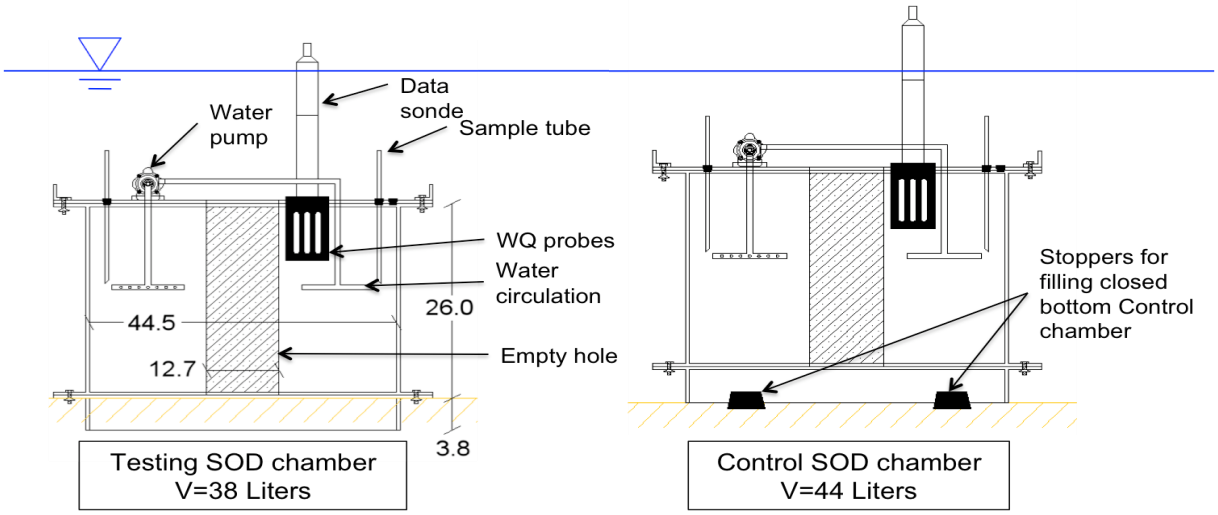
2. What is the role of anoxia in nutrient releases and sediment dynamics over a range of phosphorus concentrations?

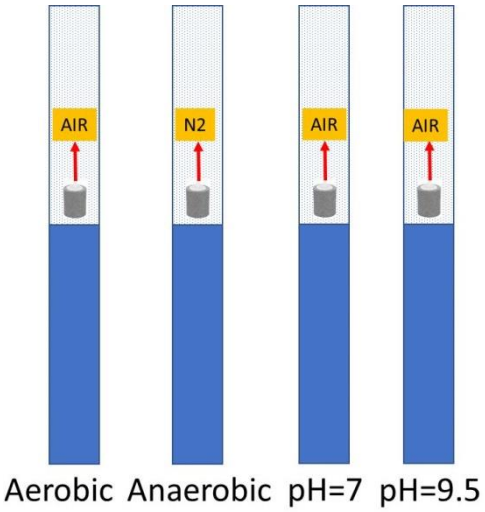
3. What is the role of pH in water column–sediment interactions and nutrient releases? How does the equilibrium phosphorus concentration change over a range of water column pH?

4. What is the sediment oxygen demand of, and nutrient releases from, sediments in Utah Lake under current conditions?
   - Science Panel charge 2.4.ii

5. What is the role of calcite “scavenging” in the phosphorus cycle?
   - Science Panel charge 2.3.v

Sediment-Water Interactions





Project Timeline

Historic Trophic State and Nutrient Concentrations in Paleo Record

- July 2019 – Sampling Analysis plan
- July 2019 – Core collection
- January 2020 –Core experimentation
- January 2020 – Technical report

Bioassays to Investigate Nutrient Limitation

- July 2019 – Sampling Analysis plan
- August 2019 to May 2020 – Bioassay experimentation
- June 2020 – Technical report

Sediment-Water Nutrient Interactions

- July 2019 – Sampling Analysis plan
- September 2019 – Sediment core collection
- December 2019 – Sediment core experimentation
- January 2020 – Technical report

Atmospheric Deposition

Objectives

1. Two experts hired for document review
    1. Dr. David Gay
        1. U of Wisconsin (Adjunct Faculty)
        2. NAPD (Research Scientist and Coordinator)
            1. National Atmospheric Deposition Program
    2. Dr. Todd McDonnell and Dr. Tim Sullivan
        1. Environmental Chemistry, Inc.

2. External atmospheric deposition experts were hired to:
    1. Review and comment on Utah Lake AD research and documents
        1. Review documents will be submitted for Science Panel review within the next week or two (early December)
    2. Help fine tune a sampling and analysis plan to help answer AD questions for the ULWQS
        1. Future task

Questions?

UTAH LAKE COMMISSION

UTAH DEPARTMENT of ENVIRONMENTAL QUALITY WATER QUALITY

UW BAYLOR BEARS MISSISSIPPI STATE CAROLINA TAR HEELS UTAH STATE BYU COLLEGE OF ENGINEERING THE UNIVERSITY OF UTAH

WFWQC FORSGREN Associates Inc